EDUCATION – Grades (Ellen Eccles Jones Education building)

Both teachers and students know that grades aren't the reason we learn, but everyone agrees that having good grades is better than having poor grades, right?! Here are some common grade calculations:

To pass a course, you must have an exam average of at least 75%. On the first three exams, you earned scores of 64%, 83%, and 72%. What is the lowest possible score you could get on the fourth exam that would earn you a sufficiently high exam average?

$$\frac{64+83+72+X}{4} \geq 75$$

$$219 + X \geq 300$$

$$\boxed{X \geq 81}$$

A	4.0
A-	3.7
B+	3.3
B	3.0
B-	2.7
C+	2.3
C	2.0
C-	1.7
D	1.0
F	0.0

Your GPA (grade point average) is a calculated by taking course letter grades and converting them to numerical values, then weighting those values based on the number of credits a course is worth.

For example, 6 credits of A and 3 credits of B- : $\frac{6(4.0)+3(2.7)}{6+3} = \frac{32.1}{9} = 3.567$

Suppose last semester you earned 5 credits of A, 6 credits of B+, and 3 credits of C. What is your semester GPA?

$$\frac{5(4.0)+6(3.3)+3(2.0)}{5+6+3} = \frac{45.8}{14} \approx \boxed{3.27}$$

PHYSICAL FITNESS – Olympic Records (HYPR Field)

The 2012 Summer Olympics Games will take place in London, U.K. from July 27 through August 12. In a depressing world full of conflict, it is inspiring to have over 200 countries compete and interact civilly – celebrating the potential of human achievement.

Run as fast as you can (without hurting yourself!) for 25 meters while someone else measures your time. Calculate your speed in kilometers per hour.

25m time (in seconds): 4.75

$\left(\frac{25\text{ m}}{4.75\text{ s}}\right)\left(\frac{1\text{ km}}{1000\text{ m}}\right)\left(\frac{3600\text{ s}}{1\text{ hr}}\right)$ Speed (km/hr): $\sim 18.95\ \frac{\text{km}}{\text{hr}}$

Compare your top speed with the following world record:

- At the 2009 World Athletic Championships, the 25 year-old Jamaican sprinter Usain Bolt ran the 100 meter event in a time of 9.58 seconds.
- Last year, the 27 year-old Kenyan distance runner Patrick Musyoki ran the 2011 Berlin Marathon (26.2 miles; 1 mile = 1.6 kilometers) in a time of 2 hours, 3 minutes, and 38 seconds.

Use the given distance and time above and convert it into a speed in kilometers/hour.

100m $\left(\frac{100\text{ m}}{9.58\text{ s}}\right)\left(\frac{1\text{ km}}{1000\text{ m}}\right)\left(\frac{3600\text{ s}}{1\text{ hr}}\right) \approx \boxed{37.58\ \frac{\text{km}}{\text{hr}}}$

Marathon $26.2\text{ mi}\left(\frac{1.6\text{ km}}{1\text{ mi}}\right) \approx 42\text{ km}$

$2\text{ hr}\left(\frac{3600\text{ s}}{1\text{ hr}}\right) = 7200\text{ s}$

$3\text{ min}\left(\frac{60\text{ s}}{1\text{ min}}\right) = +\ 180\text{ s}$

$+\ 38\text{ s}$

$7418\text{ s}\left(\frac{1\text{ hr}}{3600\text{ s}}\right) \approx 2.06\text{ hr}$

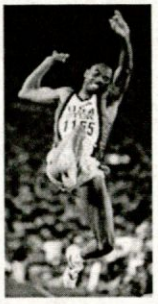
$\frac{42\text{ km}}{2.06\text{ hr}} \approx \boxed{20\ \frac{\text{km}}{\text{hr}}}$

Who would win in a race between you and the marathon runner?

$\sim 19\ \frac{\text{km}}{\text{hr}} < \sim 20\ \frac{\text{km}}{\text{hr}}$

My top sprinting speed is less than the average marathon speed!

PHYSICAL FITNESS – Olympic Records (The Quad)



The long jump is an event that has been a part of the Olympic Games since 1896 and has beginnings in the original competitions of Ancient Greece.
The current world record was set twenty years ago by American Mike Powell in Tokyo: an incredible jump of 8.95 meters (26 feet, 8 inches)!

Give long jumping a try! Take 10–20 steps to pick up speed, then jump as far as you can. Remember that your landing is important because your distance is measured by the body part that touches the ground closest to the take-off point.

Jump twice and record your distance in feet and inches. Jump 1: 9 ft. 8 in. Jump 2: 10 ft. 2 in.

[12 in. = 1 ft] Calculate your average long jump distance. 9 ft and $8\text{ in}\left(\frac{1\text{ ft}}{12\text{ in}}\right) = \frac{2}{3}\text{ ft}$ 10 ft and $2\text{ in}\left(\frac{1\text{ ft}}{12\text{ in}}\right) = \frac{1}{6}\text{ ft}$

$9\frac{2}{3}\text{ ft} \rightarrow \frac{58}{6} \rightarrow \frac{116}{12}$

$10\frac{1}{6}\text{ ft} \rightarrow \frac{61}{6} \rightarrow \frac{122}{12}$

$\left(\frac{116 + 122}{2} = 119\right)$

Ave: $\frac{119}{12} \rightarrow$ 9 ft 11 in

How much farther would you have to jump to beat the world record?

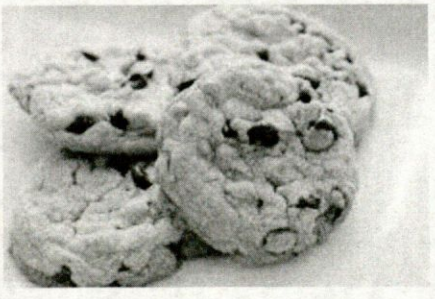
26 ft 8 in — 9 ft. 11 in = 16 ft 9 in more than twice as far!

COOKING – Altering a Recipe (Agriculture Science – Café on the Quad)

A classic American treat is the chocolate chip cookie. This list of ingredients will make about 40 cookies.

1) Suppose you live with just one roommate and want to half the recipe to make only 20 cookies.
2) Suppose you are having a party and want to triple the recipe to make around 120 cookies.

Convert the recipe measurements for each situation:



Half	*Triple*	*Original*
1 1/8	6 3/4	2 ¼ cups all-purpose flour
1/2	3	1 teaspoon baking soda
1/4	1 1/2	1/2 teaspoon salt
1/2	3	1 cup unsalted butter, softened
3/8	2 1/4	3/4 cup white sugar
1	6	2 eggs
1	6	2 teaspoons vanilla extract
1	6	2 cups jumbo semisweet chocolate chips
1/2	3	1 cup white chocolate chips
1 1/4	4 1/2	1 ½ cups chopped walnuts

3) You can fit 12-15 cookies on a baking pan, and each "batch" needs to bake for 10-12 minutes. Estimate how long it will take to bake 120 cookies for a party.

Short estimate:

$\left(\frac{120\text{ cookies total}}{15\text{ cookies per batch}}\right)\left(\frac{1\text{ batch}}{10\text{ min}}\right)$

$\frac{120\text{ cookies total}}{15\text{ cookies per batch}} = 8\text{ batches} \times 10\text{ minutes per batch}$

$= \sim 80\text{ min or } 1\text{ hr. } 20\text{ min}$

Long estimate:

$\frac{120\text{ cookies total}}{12\text{ cookies per batch}} = 10\text{ batches} \times 12\text{ minutes}$

$= \sim 120\text{ min or } 2\text{ hrs.}$

LANGUAGES – Global Proportions (Old Main)

There are approximately 7,023 million (7.023 billion) people in the world.
There are over 700 distinct languages that are spoken by at least one million people.

GLOBAL LANGUAGES – TOP 12 (estimates ranked by number of native speakers)

Language	Native Speakers	Other Speakers	Total Speakers
Mandarin Chinese	873 million	178 million	1,051 million
Hindi	370 million	120 million	490 million
Spanish	350 million	70 million	420 million
English	340 million	170 million	510 million
Arabic	206 million	24 million	230 million
Portuguese	203 million	10 million	213 million
Bengali	196 million	19 million	215 million
Russian	145 million	110 million	255 million
Japanese	126 million	1 million	127 million
German	101 million	128 million	229 million
French	67 million	63 million	140 million
Urdu	61 million	43 million	104 million

Sources: < *Ethnologue: Languages of the World*, 15th ed. (2005), U.S. Census Bureau, Wikipedia.org >

The column "Other Speakers" indicates how many non-native speakers have learned that language.
Write a list with the languages ranked in order of non-native speakers.

Mandarin (178 million), English (170), German (128), Hindi (120), Russian (110), Spanish (70), French (63), Urdu (43), Arabic (24), Bengali (19), Portuguese (10), Japanese (1)

If we imagine a group of just 1,000 people accurately representing the entire world population, how many of the 1,000 people would speak:

a) Chinese ~ 150

b) Spanish ~ 60

c) English ~ 73

d) Arabic ~ 33

e) Japanese ~ 18

f) Russian ~ 36

$$\left[\frac{\#\text{ total speakers}}{\text{world population}} \times 1{,}000\right]$$

Based on this data, your career goals, and personal interest, which language (after English) would you consider learning next?

- your choice -

PHYSICS – Astronomy (Science Engineering Research)

At the Clark Planetarium there was a machine that would display your weight on other planets.
Using Newton's equations for the force of gravity, you can calculate it yourself!

PLANET SIZE INFORMATION

Source: < http://nssdc.gsfc.nasa.gov/planetary/factsheet/ >

Planet	Mass (kg)	Radius (m)	Planet	Mass (kg)	Radius (m)
Mercury	3.3×10^{23}	2.4×10^{6}	Jupiter	1.9×10^{27}	7.0×10^{7}
Venus	4.8×10^{24}	6.0×10^{6}	Saturn	5.7×10^{26}	5.8×10^{7}
Earth's Moon	7.3×10^{22}	1.7×10^{6}	Uranus	8.7×10^{25}	2.5×10^{7}
Mars	6.4×10^{23}	3.4×10^{6}	Neptune	1.0×10^{26}	2.4×10^{7}

$$Force\ of\ gravity = \frac{(gravitational\ constant) \cdot (one\ object\ mass) \cdot (other\ object\ mass)}{(distance\ between\ objects)^2}$$

$$Force\ of\ gravity = \frac{G \cdot m_1 \cdot m_2}{d^2}$$

The massive objects are you and the planet you're standing on.
The distance between you and the planet's center of mass is simply the radius of the planet.
The value of the gravitational constant: $G = 6.673 \times 10^{-11}\ \frac{m^3}{kg \cdot s^2}$

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1. What is your mass in kilograms? 70 kg [1 pound = 0.453 kilograms]
If you are not sure, just estimate (Teacher Kenneth is around 70 kg).

2. Pick one of the planets (or moon) from the table above to apply in the following questions: [Mars]

3. If you traveled to [Mars], what force of gravity (in Newtons) would you feel on its surface?
Remember exponent rules!

$$F_g = \frac{(6.673 \times 10^{-11})(70\ kg)(6.4 \times 10^{23}\ kg)}{(3.4 \times 10^{6}\ m)^2} = \left(\frac{6.673 \times 6.4 \times 70}{(3.4)^2}\right)\left(\frac{10^{-11} \cdot 10^{23}}{(10^6)^2}\right)$$

$$= (258.6)\left(\frac{10^{12}}{10^{12}}\right) \qquad \left[\frac{b^a}{b^a} = 1\right]$$

$$F_g = 258.6\ N$$

4. What is the acceleration due to gravity (in meters/second^2) on [Mars]?

Newton's 2nd law: $Acceleration = \frac{Force\ of\ gravity}{Mass}$ $= \frac{258.6\ N}{70\ kg} = \sim 3.7\ \frac{m}{s^2}$

5. Solve for your weight (in kilograms) on [Mars] using the following formula.
[acceleration due to gravity on Earth = 9.8 m/s^2]

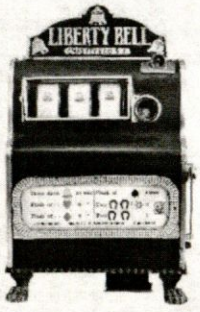
$$Weight\ in\ kilograms = (object\ mass) \cdot \left(\frac{acceleration\ due\ to\ gravity\ on\ chosen\ planet}{acceleration\ due\ to\ gravity\ on\ Earth}\right)$$ → $9.8\ \frac{m}{s^2}$

$$Weight = (70\ kg) \cdot \left(\frac{3.7}{9.8}\right) = \boxed{\sim 26.4\ kg}$$

6. If astronauts were living on [Mars], how would life be different there?

Because 26.4 kg is almost three times less than 70 kg, the astronauts could jump higher, lift heavier objects, etc. (until their muscles weakened because of the lower gravity)

STATISTICS – Gaming Probability (Mathematics)



Slot machines are the most popular gambling method in casinos and constitute about 70% of the average U.S. casino's income. The first slot machine (the *Liberty Bell*, invented in 1895) had 3 spinning wheels with 5 symbols each.

On the original slot machine, how many possible outcomes are there?

$5 \cdot 5 \cdot 5 =$ 125 combinations

What is the probability of getting identical symbols on each wheel (a jackpot)?

$\frac{5 \text{ possible jackpots}}{125 \text{ total combinations}} =$ 0.04 or 4%

If the machine only cost $0.25 (a quarter) per spin, and the jackpot payout was $6.00, would you play? Defend your answer. 4% means you could expect a jackpot every 25 plays, so

$25 \text{ plays} \left(\frac{25¢}{1 \text{ play}}\right) =$ $6.25 cost > $6.00 jackpot. Statistically, you would lose money over time.

Blackjack, or Twenty-One, is another popular casino game that can be one of the most probable for a player to win money. Apparently the game was played as far back as the 1600s because the Spanish author (and gambler) Miguel de Cervantes characterized cheaters at *ventiuna* in one of his short stories.

The object of the game is to be dealt cards that sum up to or as close to 21 without going over (a "bust"). All cards 2-10 are worth their numerical value; face cards (JQK) are worth 10; an Ace can be worth either 1 or 11 depending on its best use. The players and the dealer are dealt two initial cards. Then each player chooses if they would like another card to get closer to 21 or just hope that their current sub-21 total will be the highest at the table.

[If you are unfamiliar with face cards, a standard deck has 4 suits each containing 13 cards (2 3 4 5 6 7 8 9 10 Jack Queen King Ace)]. ***Note**: Suits do not matter in blackjack scoring.

$4 \times 13 = 52$ cards total

If you are playing blackjack, how many 10-point cards are there in one standard deck?

all worth 10 points { 10 J Q K } 4 of each suit → $4 \times 4 =$ 16 cards worth 10-pts

What is the probability of initially getting dealt a *blackjack* hand (a 10-point card and an Ace) from a standard card deck?

$\left(\frac{16}{52}\right)\left(\frac{4}{51}\right) =$ 0.024 or 2.4%

4 aces from remaining cards

Suppose you are the only person playing single-deck blackjack against the dealer. The dealer has stopped with a hand of (3, Queen, 5). You currently have a hand of (King, 7). What is your probability of winning (getting a sum higher than 18 but no more than 21) if you draw just one more card?

dealer: 3 + Q + 5 = 18

you: K + 7 = 17 → $18 < 17 + ? \leq 21$

4 As, 4 2's, 3 3's, 4 4's → $\frac{15 \text{ good cards}}{(52-5) \text{ cards in play}} = \frac{15}{47} =$ 0.319 or 32%

Continuing from the situation above: If you had bet $20 that round, and there was $80 to be won, would you draw another card? Defend your answer. 32% means you could expect to win once every 3 plays, so

$3 \text{ plays} \left(\frac{\$20}{\text{play}}\right) =$ $60 cost < $80 winnings. Statistically, go for it!

Extra Gambling Notes:

Slot Machines: A computerized slot machine with 256 virtual symbols per reel would allow up to $256^3 = 16{,}777{,}216$ final positions. The manufacturer could choose to offer a million dollar jackpot from a $1 bet, confident that, on average, it will only happen every 16.7 million plays.

Blackjack: Most blackjack dealers are instructed to shuffle up to six decks of cards together to gain significant statistical advantage and discourage card counting.